IBM INVENTORY CONTROL

650

Data Processing System

with Magnetic Tape

Input/Output

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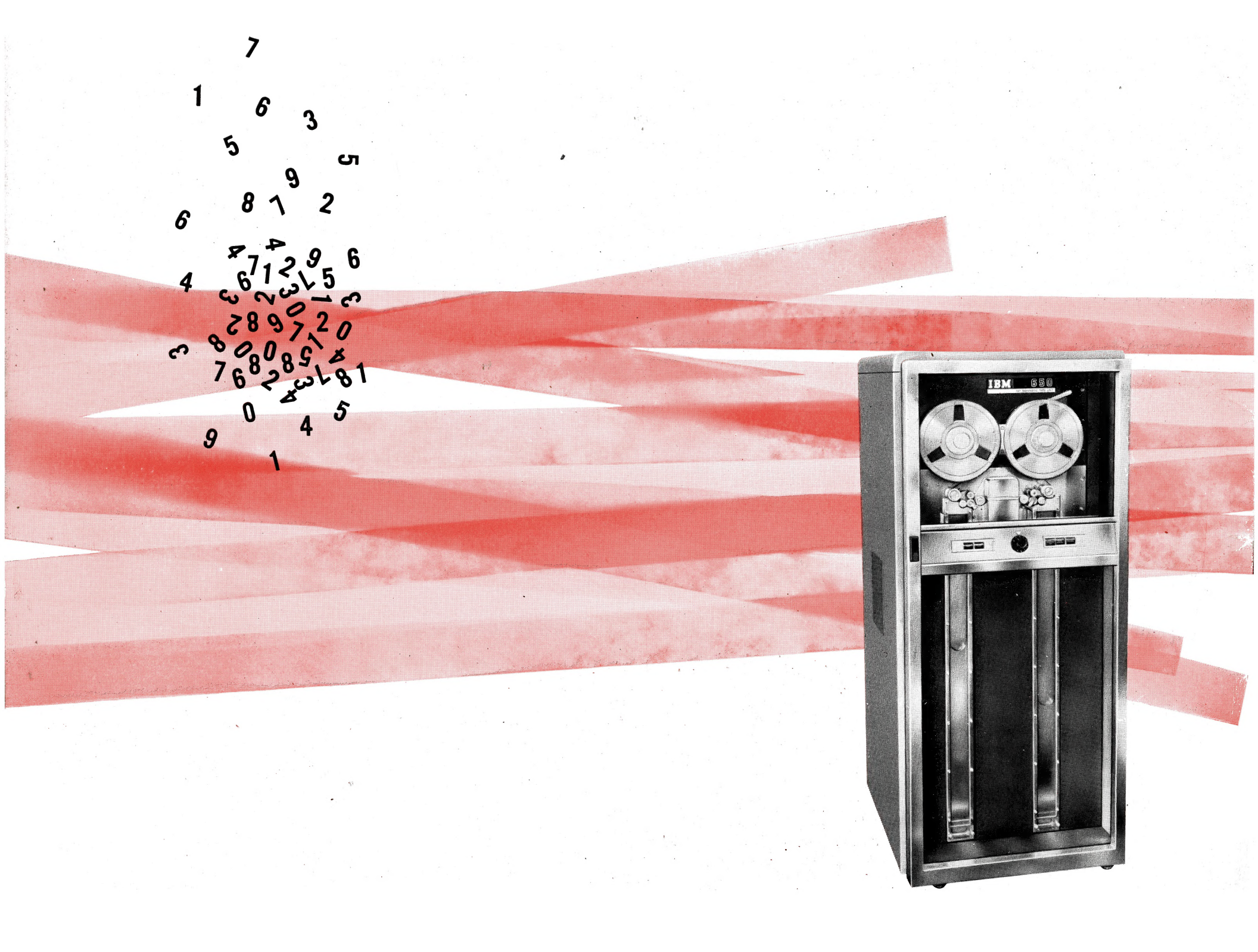
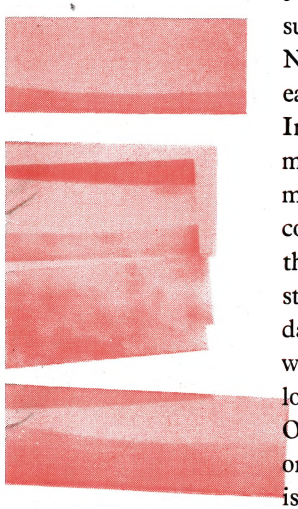

IBM 650

ABOUT INVENTORY CONTROL



What proportion of a company's capital assets are tied up in inventories? Even a casual examination of company accounts shows that it may be as high as 50%; it will almost certainly represent a very substantial investment.

Now, money costs nothing to maintain—indeed, by earning interest it more than pays for its keep. Inventories, unfortunately, do not do this. Their maintenance is an expensive business and can absorb as much as 25% of the value of the inventories concerned in a year. The factors contributing to this expense are many: the cost of warehousing and storage space; insurance; depreciation arising from damage or deterioration due to storage, handling, weather, age, evaporation or shrinkage, and so on; or losses due to obsolescence.

Of course inventories are a necessary part of any organization making, selling, or servicing goods. But it is as well to be clear that they are, in themselves, a necessary evil and an uneconomic investment. It follows that the reduction of inventories to an absolute minimum is the constant aim of good management. The large volume of transactions likely in any sizeable inventory, the heavy clerical burden involved in accounting for them, and the large economies inherent in a closer control of inventories have made the application of IBM Electronic Data Processing Machines in this field widespread and highly profitable.

ABOUT THIS DEMONSTRATION

There are as many inventory control systems as there are companies maintaining inventories. Nevertheless, if these systems are to be of any use to management they must all be capable of answering certain basic questions.

WHAT IS IN STOCK?
IS IT ENOUGH?
IS IT TOO MUCH?
WHAT SHOULD BE ORDERED?

These questions may be re-interpreted and elaborated in many ways, but they are fundamental. In this demonstration we shall show how the IBM 650 Data Processing System deals with these questions as they apply to a large and complex inventory, and how it does so daily for the *complete* inventory, in a single processing step. The automatic, self-supervisory nature of the operation and the concept of management by exception will be discussed in the following notes.

It is worth pointing out that this demonstration does not pretend to lay down *the* IBM method of inventory control, though the fundamental routine has wide application in electronic data processing. We have taken as our point of departure the inventory problem facing a company engaged on light engineering assembly, where many components are sub-contracted or bought from outside suppliers. Emphasis has been placed on the routine for outside purchase, though essentially the same procedure is applied to raising manufacturing orders on the factory.

DAILY TRANSACTIONS ARE RECORDED ON IBM CARDS

Punched cards are the common language of IBM machines. For high-speed volume input to a computer system they are frequently converted to IBM magnetic tape, but the initial recording is always made on cards. The reasons for this are many. Cards are cheap, they are easily punched and verified, and as they are unit records they are easily grouped and edited on a sorter. Cards are conveniently filed and referred to visually. A wide range of well-tried equipment exists for handling them, automatically and at high speed, and many of the simpler operations (listing registers, balancing, sorting, etc.) are economically achieved on conventional IBM machines, leaving the computer system free to tackle the complex volume work for which it was designed. Three different types of card serve to record all transactions involved in this inventory. For the purposes of the demonstration they are shown punched by three different methods.

1. GOODS RECEIVED NOTE

All goods are inspected before being accepted in stores, and the results of inspection are recorded on a Goods Received Note, which is itself an IBM card. In the spaces provided the inspector writes the Part No., the Order No., the Quantity Accepted, and the Type of Delivery (Full, Part, Short or Over). If parts are rejected the details are also entered, for subsequent analysis. The Purchase Department complete the card by inserting the supplier's quoted Unit Price (should the invoiced price differ an Adjustment Card will be raised at a later stage).
The handwritten cards are now passed to the 026 Printing Punch. The operator reads the information on each card as it is fed through the machine and punches it into the *same* card, which thus performs the dual function of source document and punched record. At the same time this information is printed along the top edge of the card.
After cards have been punched they are verified on the 056 Verifier. Any errors are positively identified and the cards speedily repunched.

2. ON ORDER CARD

Purchase orders to outside suppliers are typed on an IBM 884 Typewriter Tape Punch. The 884 consists of an IBM Electric Typewriter to which is linked an 8-channel paper tape punch. The machine is programmed so that as an order is typed all the relevant information for the On Order record is punched into the tape.
Paper tapes are despatched to the machine room where they are automatically converted to punched and printed IBM cards by the 047 Tape to Card Punch, at a speed of 18 cols. per sec. By this means both manual key-punching and verifying are eliminated, and the flow of information to the 650 System speeded up.

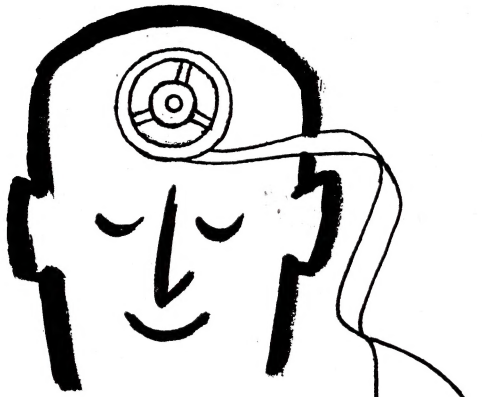
3. STORES ISSUE DOCKET

A storekeeper issuing parts will pull from a file an IBM card, pre-punched with the reference information for that part and boldly printed with the Part No. On this card he enters simply the Quantity Issued and the Department and Job No. charged, in the form of pencil strokes in predetermined writing positions. The cards are fed to the 519 Document Originating Machine; the Mark Sensing feature on this machine enables it to read the pencil marks and convert them to punched holes in the card at a speed of 100 cards per minute. Simultaneously the cards are punched and printed with a Document No. Again, the manual key-punching and verifying stages have been by-passed and information got to the 650 System speedily and economically.
As will be seen from the cards, the Goods Received Note and the Stores Issue Docket also serve to record other types of receipts and issues, such as returns from the shop floor or to a supplier, transfers from one warehouse to another, adjustments in quantity or value, etc.

The final stage of input data preparation is the grouping by Part No. and Type of Transaction of the three types of card. This is done by the IBM 083 Sorter, working at a speed of 1000 cards per minute. Now the day's transactions are ready for electronic data processing.

THE MASTER INVENTORY RECORDS ARE ON MAGNETIC TAPE

The ability of the 650 System to review each day *all* the records for a massive inventory is dependent on the highly compact storage of information possible on magnetic tape and its very fast reading and writing speeds. From the tape layout below it will be seen how comprehensive the record for a single Part No. is, yet it occupies only $\frac{3}{4}$ inch of tape. 4360 such records can be read—or written—by a tape unit *in one minute*.



THE TAPE RECORD

Part No.	8 digits
Description (15 letters)	30 digits
Unit of Measure	3 digits
Balance on Hand	5 digits
Quantity on Order	5 digits
Total Issues to Date (Current Control Period)	5 digits
Total Issues to Date (Current Schedule) ...	6 digits
Planned Issues (per Control Period)	5 digits
Issues Tolerance	2 digits
Last Activity Day	3 digits
Average Unit Price	10 digits
Average Unit Price Tolerance	2 digits
Total Inventory Value	10 digits
Minimum Inventory Level (in Control Periods)	3 digits
Maximum Inventory Level (in Control Periods)	3 digits
Lead Time (in days)	3 digits
Current Economic Order Quantity	5 digits
Schedule Requirements 1	5 digits
Schedule Requirements 2	5 digits
Schedule Requirements 3	5 digits
Order No. of oldest outstanding order... ...	5 digits
Delivery Day	3 digits
Quantity	5 digits
Order No. of second outstanding order ...	5 digits
Delivery Day	3 digits
Quantity	5 digits
Total ...	149 digits

$\frac{3}{4}$"

Records are in Part No. sequence

Most of the items included in the tape record are self explanatory; a few notes follow on those which are not.

Control Period
Maximum and Minimum Inventory Levels, for instance, are expressed in 'Control Periods'; they are simply days, weeks, months, etc. The appropriate Control Period is coded in the Part No. It is made necessary by the fact that movements for some low usage parts may not be significant if taken on a daily basis, though the weekly or monthly average should conform to the production plan.

Lead Time
This is the time required for an outside supplier to deliver purchased parts, plus a safety margin of some days for order processing, inspection, etc.

Tolerances
Average Issues and the Average Unit Price of a part are not allowed to vary from Planned Average Issues and the previous Average Unit Price by more than certain predetermined percentages which are the tolerances.

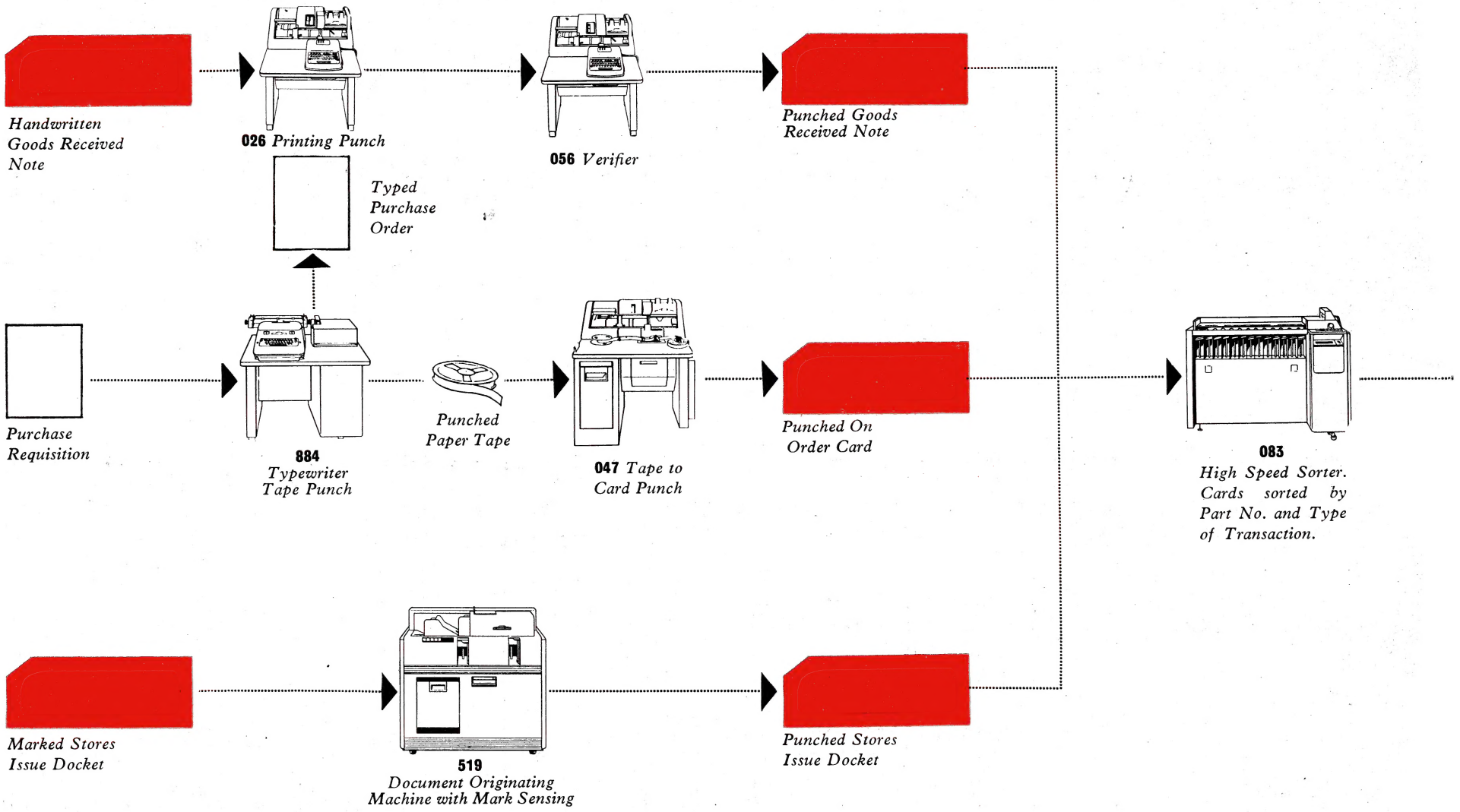
Schedule Requirements and Current Economic Order Quantity
An inventory must accurately anticipate production needs. These are laid down initially in a production programme and expressed in terms of finished units to be completed during each of a series of scheduled periods. One of the first and most important jobs of the 650 System is to break down this production programme into a total parts requirements forecast for every individual part which enters into the construction of the units to be built during each scheduled period. These parts requirements determine the level of inventories, and therefore Schedule Requirements for the current period and the two following (each is one month) are included on the inventory tape record. The parts requirements forecast is up-dated monthly, and at that time the Schedule Requirements on the inventory tape are also revised. In addition a particularly interesting calculation is carried out to determine the Current Economic Order Quantity, i.e. the most economic quantity of each part to order, should the need to re-order be signalled during the current schedule period. The following formula is used:—

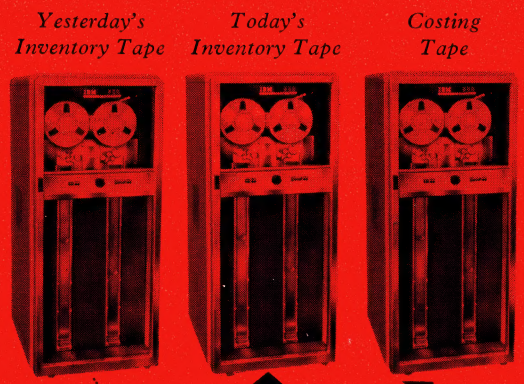
$$EOQ = \sqrt{\frac{2400RC}{MP}}$$

where R = monthly requirements (for applicable schedule period)
C = overall cost of placing and processing an order
M = yearly stock maintenance cost, as a percentage of the unit price
P = unit price of part

This formula is arrived at by equating the cost of *acquiring* stock (which includes a proportion of the overheads of the purchase, inspection, accounts and various other departments) with the cost of *maintaining* parts in stock (which involves many factors mentioned in the introduction, such as storage, depreciation, obsolescence, etc.). Although it is by no means the only formula for evaluating the Economic Order Quantity, it has been widely and successfully applied to many inventory calculations.

INPUT DATA PREPARATION

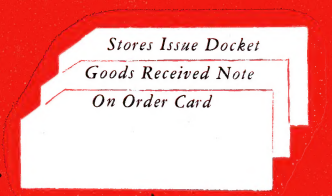


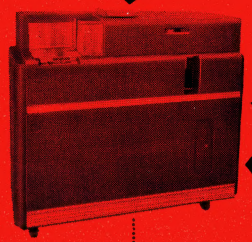


727 *Magnetic Tape Input and Output Units*

653 *Immediate access Magnetic Core Storage*

The electronic heart of the 650 System is its arithmetical and logical unit, which houses a magnetic drum storing 20,000 decimal digits, and is capable of making 78,000 additions or 138,000 logical decisions in one minute. Connected by cables to it are the input and output devices. Data is read in from cards and magnetic tape; results are punched into cards, printed, or written on to magnetic tape. Tape reading and writing take place via immediate access magnetic core storage. *The complete system is automatically self-checking.* Turn to the next page for a full account of the daily processing routine.





533 *Read-Punch Unit*

650 *Basic Computing Unit with Magnetic Drum Storage*

407 *Line Printer*

DAILY 650 PROCESSING

DAILY 650 PROCESSING

The first stage in the operation is to feed the ' programme ' into the 650 from cards. When this has been done every single instruction needed to carry out the whole job is stored in the 650's magnetic drum ' memory,' and the machine is ready for automatic processing. Daily transactions are fed in from cards and the matching records on tape are loaded into magnetic core storage where they are instantly accessible to the 650.

Now, *in a single processing operation*—

* A New Completely Up-dated Inventory Tape is Written

Following its stored programme of instructions the 650 computes all changes brought about by the day's transactions to the balances and other information contained in the tape record. When these revisions have all been made the up-dated record is assembled in magnetic core storage, and written on to a second tape, which becomes the master inventory tape for the following day's processing. If there have been no transactions for a particular Part No., the inventory record is simply transcribed from the old tape to the new.

* Extended Issues are Written on Tape

A record of all issues, including the department and job charged, is written on tape daily. From this tape departmental cost summaries can be computed whenever required. More detailed cost breakdowns can be prepared by sorting the issues records on magnetic tape. Alternatively, a 537 Read-Punch Unit can be added to the 650 System and the Stores Issue Dockets punched with their extensions, for subsequent sorting and summarizing on conventional punched card equipment.

* A Management Exception Report is Printed

The 407 Printer output is a report that pin-points those inventory conditions calling for management action. Under this heading come, for instance, the need to re-order certain parts or to expedite existing orders for them; and to investigate transactions which show a departure from the norm set in the production plan—low or excessive issues, fluctuations in price outside the tolerances, and irregular receipts.

* Signal Cards are Punched for Clerical Review

For every exception condition printed in the management report a Signal Card is punched by the 533 Read-Punch Unit. Signal Cards provide the greater amount of detail required by departments, such as the Purchase Department, who will be called on to take corrective action. There are five types of Signal Card: —

RE-ORDER
EXPEDITE
CHECK RECEIPTS
CHECK ISSUES
CHECK PRICE

These cards are sorted into their respective categories, listed on an off-line printer, and the listing despatched to the departments concerned.

THESE ARE THE POSSIBLE CALCULATIONS FOR EVERY PART No.

1. SEQUENCE OF THE INPUT CARDS IS CHECKED.

2. ON ORDER CARDS

— Quantity is added to the ' On Order ' quantity on the tape record.

— Order No., Quantity, and Delivery Day are written on the tape.

3. GOODS RECEIVED NOTES

— Quantity is added to the Balance on Hand.

— Quantity × Unit Price is added to the Inventory Value.

— Quantity is subtracted from ' On Order ' quantity and from applicable Order on tape.

— IF delivery was complete the applicable Order information is cancelled, and any other Orders on the tape moved up to fill the gap.

— IF it was noted by the Inspection Department that delivery was part, short, or over, the Order Quantity is reduced by the quantity received.

— IF, however, the 650 finds a discrepancy that was *not* noted by the Inspection Department a CHECK RECEIPTS condition arises: a line is printed on the Daily Exception Report and a Signal Card is punched.

4. AVERAGE UNIT PRICE CALCULATION

— When all receipts have been processed, the new Average Unit Price is calculated from the following formula and substituted for the previous Average Unit Price on the tape.

$$\text{New A.U.P.} = \frac{\text{New Inventory Value}}{\text{New Balance on Hand.}}$$

5. STORES ISSUE DOCKETS

— Quantity is subtracted from Balance on Hand.

— Quantity is added to Total Issues (*a*) for the current Control Period, (*b*) for the current Schedule Period.

— Quantity × new Average Unit Price is written on the Costing Tape, together with reference information (Date, Document No., Department and Job Charged).

— The Day of Issue is substituted for the previous Last Activity Day on the tape.

6. RE-ORDER POINT CALCULATION

(*a*) $\dfrac{\text{Balance on Hand} + \text{Quantity on Order}}{\text{Planned Issues}} = \text{Planned Availability.}$

(*b*) Minimum Inventory Level + Lead Time = Re-order Point

(*c*) IF Planned Availability $\leqslant$ Re-order Point a RE-ORDER condition arises: a line is printed on the Daily Exception Report and a Signal Card is punched.

7. EXPEDITE CALCULATION

IF $\dfrac{\text{Balance on Hand}}{\text{Planned Issues}} \leqslant$ Minimum Inventory Level

an EXPEDITE condition arises: a line is printed on the Daily Exception Report and a Signal Card is punched.

8. EXCEPTIONAL ISSUES CALCULATION

IF $\dfrac{(\text{Planned Issues} - \text{Actual Issues})\ 100}{\text{Planned Issues}}$ Issues Tolerance

then a CHECK ISSUES condition arises: a line is printed on the Daily Exception Report and a Signal Card is punched.

9. EXCEPTIONAL PRICE FLUCTUATION

IF $\dfrac{(\text{Previous A.U.P.} - \text{New A.U.P.})\ 100}{\text{Previous A.U.P.}}$ A.U.P. Tolerance

then a CHECK PRICE condition arises: a line is printed on the Daily Exception Report and a Signal Card is punched.

MANAGEMENT BY EXCEPTION

There are people who fear that a computer is only an expensive means of generating vast seas of figures for management to wade through. One of the objects of this demonstration is to dispel such fears by putting into practice what is one of the fundamental principles of IBM Data Processing—Management by Exception. Management decisions do not have to be taken when everything is going according to plan; they must be taken when departures from the plan occur or are foreseeable. Here are precisely the 650's terms of reference: to handle and maintain inventory records entirely in its own electronic language *except* where conditions arise that make management intervention necessary—then, and only then, to translate them into written output.

No other Data Processing System exists which is at the same time so powerful, so widely used and so dependable as the 650.

Over 700 machines in use the world over have given proof of that.

It may be that IBM Data Processing holds the answer to your problems—in inventory control or in other fields. If you think so, why not talk matters over with us? Consultation is free, carries no obligation on your part, and may pay you handsomely.

After all, your problems are our business.

U.K. Form No. 52-5701 Designed and produced by C. R. Casson Ltd. Printed by Drydens Printers Ltd., London, N.W.10

For sample documents

IBM

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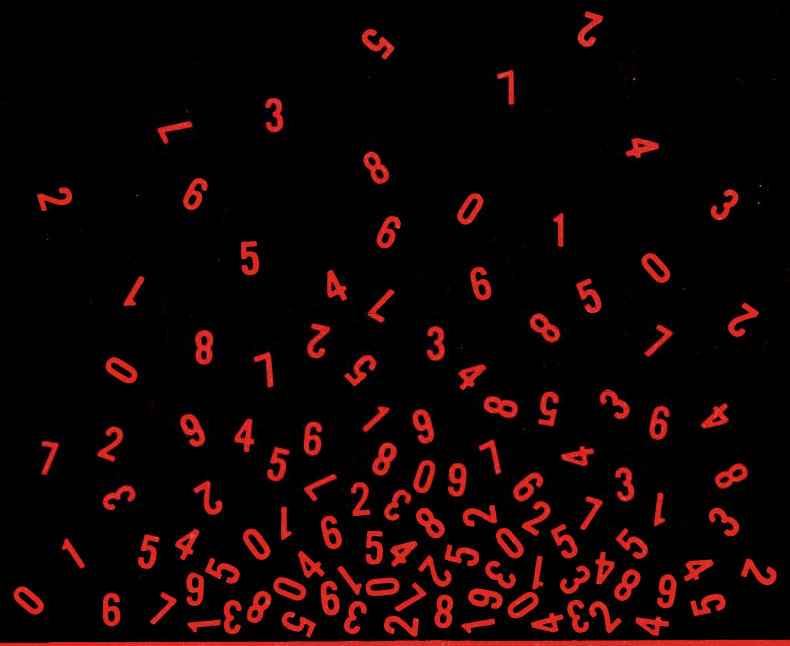

IBM

INVENTORY CONTROL

650

Data Processing System

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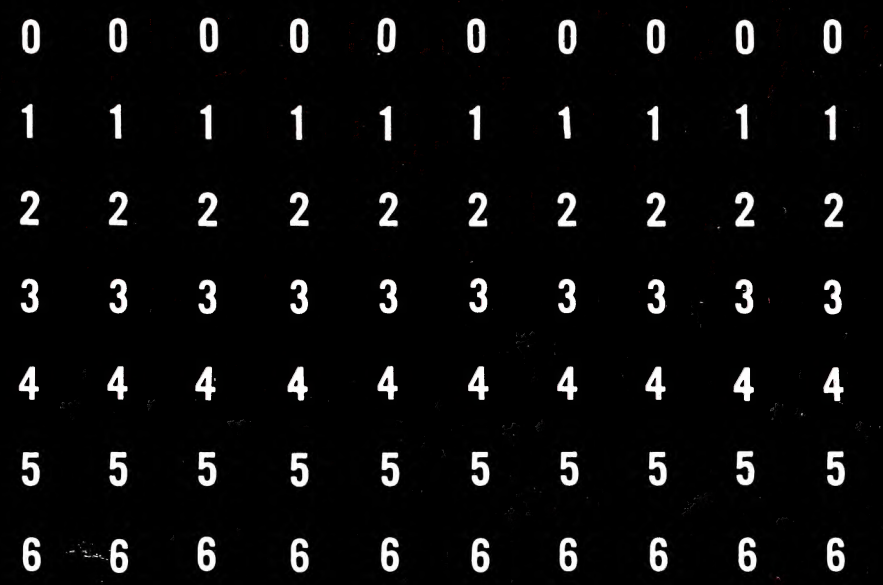
Input/Output